March 2009

Welcome to the UDOT Research Division March 2009 Edition Newsletter.

The newsletter is a quarterly publication that provides current information on the Division's research activities.

Our goal in *Research* is to be at the forefront of innovation, and we will be using this newsletter to bring you information on what's new and progressive in transportation. We will also share with you what UDOT is researching and how we are implementing new technologies.

Sincerely,
The UDOT Research Team

The UDOT Research Team (left to right)

Abdul Wakil, Technology Transfer Engineer
Barry Sharp, New Products Specialist
Debbie Heim, Research Technician
Michael Fazio, Deputy Director for Research
Shana Lindsey, Director for Research & Bridge Operations
Ken Berg, Development Engineer
Rae Ann Jensen, Office Specialist
Joni DeMille, Library Tech. Transfer Technician
Daniel Hsiao, Research Project Manager
Blaine Leonard. Research Project Manager

In This Issue: (click on desired article, click on logo at top to return to this page)

By: Michael Fazio
UDOT Research Division

Research Project Champions

Many research projects we are completing provide information on products, ideas or methods that could improve our business at UDOT.

The improvements require investment of resources to make changes suggested by research. Changes may vary from writing new standards to changing whole processes.

Research champions can foster implementation of research results. A champion is someone who is passionate about the research and would follow the research through the end. The champion's primary roles are:

- Propose research projects,
- Assess the research project's progress
- Review the research results
- Facilitate the implementation of results

Champions should have direct interest in the research work. Many research projects are now part of UDOT standards and practice because of the diligent work of their champions. While it is encouraging to see a lot of projects' results being implemented, we have a few projects that are not receiving the attention they should from the champions.

To reduce the number of orphan projects, we are asking each research group to select only research projects that their group would use and to provide champions that care about the research. If the champion of an active project changes positions or otherwise becomes unable to continue their role in the project, we would ask that the champion or the group leader help to find a new champion to fill this role. We are encouraging each group to meet before the UTRAC workshop and facilitate the collection of ideas and write up problem statements. Each research group liaison will be available to assist group leaders in preparing problem statements that fit the needs for the group. I hope you enjoy UTRAC in April.....❑

By: Blaine Leonard
UDOT Research Division

It's UTRAC Time Again

As April draws near, the Research Division is busy preparing for the annual UTRAC Workshop, the event where we gather together to discuss the research needs of UDOT, and decide which ones are the highest priority.

As April draws near, the Research Division is busy preparing for the annual UTRAC Workshop, the event where we gather together to discuss the research needs of UDOT, and decide which ones are the highest priority. This year's workshop is scheduled for April 7, and will once again be held at the SLCC Larry Miller Campus near 90th South in Sandy. One of the new features of the workshop this year is on-line registration. You may have noticed the "UTRAC" button on the UDOT web page, or on the Research page of the UDOT web. Clicking this button takes you to the registration site where you can sign up to be involved in the workshop.

The one-day UTRAC Workshop will assemble people from UDOT, FHWA, the Universities, consulting firms, contractors, and vendors. It will be an opportunity to not only discuss research efforts, but also to have general discussions about the many initiatives and projects that UDOT is undertaking. As usual, the participants will gather in small discipline-specific groups to assess our progress and map out directions for new research. The highest priority Problem Statements selected by each of these groups will be considered for funding by the Research Division.

Last year, at the 2008 UTRAC Workshop, Shana Lindsey, the Director of Research and Bridge

Operations described that the innovations we have achieved at UDOT are the result of the partnering environment we have with academia and industry, where we come together and envision new technologies, and then implement them in the Department. She challenged us to keep up the innovative pace to deal with the rapidly changing demands in our industry. UTRAC is one of the venues where we achieve that synergy and focus on new solutions to new challenges.

At the 2008 UTRAC Workshop, 140 individuals evaluated fifty-one new research problem statements, and selected 35 of them as priorities. Of these, the Research Division was able to fund nine problem statements, with a total contract value of about $480,000. Most of these are funded with federal "State Planning and Research (SPR)" dollars allocated to the Department each year. The projects will evaluate asphalt placement, reclamation and life-cycle issues, refine our ability to understand environmental and land-use impacts of road construction, improve our traffic management capabilities, enhance our techniques for foundation design and construction, develop better hydraulic modeling capabilities, and improve our implementation of accelerated bridge construction. Our projects cover a very broad spectrum of transportation issues.

Problem Statements are prepared and submitted in advance of the UTRAC Workshop, with a deadline of March 19. They can be submitted through the leader of the discipline group or directly to the Research Division. Problem Statement forms, a list of the group leaders, and other pertinent information are provided on the Research web site under the "2009 UTRAC Workshop" topic.

For more information about the workshop, review the information on our web site, or contact David Stevens (801-965-4377, davidstevens@utah.gov) or Michael Fazio (801-957-8595, mfazio@utah.gov) in the Research Division. Bring your problems and innovative ideas to the UTRAC workshop this year.....❑

By: Dr. Michael Darter & David Stevens
Applied Research Associates & UDOT Research Division

Implementation of The AASHTO Mechanistic-Empirical Pavement Design Guide in Utah

The new Design Guide will change significantly the way pavements are designed and the efficiency of results obtained.

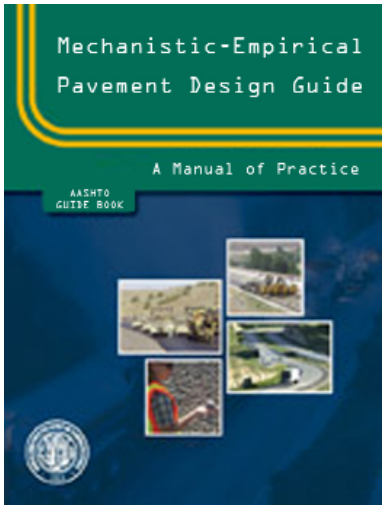
Background

The steps required to implement the new AASHTO Mechanistic-Empirical Pavement Design Guide (MEPDG) Interim Edition in UDOT are nearing completion. This new-generation pavement design and analysis procedure is based on fundamental engineering principles. It will replace the old empirical AASHTO Design Guide (AASHTO93) that was developed in 1961.

Implementation Process

UDOT was among the first state DOTs to implement the original "Interim" AASHTO Design Guide in the 1960's. Thus, it was natural for Utah to join the Lead State Group to be among the first to begin implementation of the MEPDG. It was fully recognized that implementation would require a dedicated effort from UDOT staff and management, as did the original guide, into daily activities of the Department.

The MEPDG is a very major upgrade, and the full implementation process requires several years of effort and additional resources to obtain reliable inputs, train staff, and calibrate the MEPDG to Utah conditions. A Technical Advisory Committee (TAC) comprised largely of UDOT Central and Regional materials and pavement engineers, and staff from Planning Statistics, Asset Management, and Research, was established to lead the effort and provide guidance during implementation.



The implementation of the MEPDG in UDOT is nearing completion from a technical standpoint. However, there still remains considerable training and additional work in materials testing. Some new lab equipment has already been purchased by the Department to aid in the implementation. It is expected that comparative pavement designs will continue to be performed, and training will be held this coming spring and summer prior to full implementation of the MEPDG.

Benefits to UDOT

The following are some of the many anticipated benefits to UDOT from implementation of the MEPDG:

Superior Engineering Tool- The MEPDG is much more than a thickness design procedure. Inputs consider key traffic, climate, structure, material, and construction factors, which is far more critical inputs than the AASHTO93 requires. Thus, designs developed by this new method would much more directly consider the site conditions and specific materials and design features proposed for use on a project. The result will be lower life-cycle costs and longer life pavements.

Design Reliability- The reliability in the AASHTO93 is seriously flawed, which results in an ultra-conservative design of the pavement for 4 to 6 times the expected traffic. The MEPDG approach to reliability eliminates this deficiency and provides realistic designs for high traffic.

Economic Savings to Utah- The new pavement design procedure will provide a more optimal design for projects. This will provide economic savings to the Department (and tax payers), often in terms of lower initial cost and/or future maintenance and rehabilitation costs due to more effective use of materials and controlling of key types of deterioration.

Improved Conditions for Traveling Public- Implementation of the MEPDG will result in economic savings and improved safety for the traveling public and commercial vehicles due to the following conditions:

- Reduced lane closures for maintenance and rehabilitation activities due to longer pavement life.
- Reduced highway user delays due to fewer lane closures.
- Improved safety and efficiency due to fewer lane closures.

Tools for Innovative Contracting- The MEPDG are a comprehensive engineering analysis and design tool. It is ideal for design-build projects and to assist in developing performance-related specifications and warranty specifications. It can also be used to predict the effects of substandard quality of construction by establishing the consequences in terms of future pavement life and costs of maintenance and rehabilitation.

Improved Management of Highway Network- The MEPDG can be used in many ways to improve the management of the state's highway network. Key ways are (1) improved pavement management activities through use of prediction models to predict remaining life and to program future pavement prevention activities, (2) integration into highway cost allocation studies including impacts of truck size and weight, and (3) addressing of questions concerning the consequence of various rehabilitation policies.

Administrative Changes

Implementation of the MEPDG and its efficient usage require changes. Several groups within UDOT will need to interact more often and coordinate their work efforts to obtain the inputs in a timely manner, as outlined below:

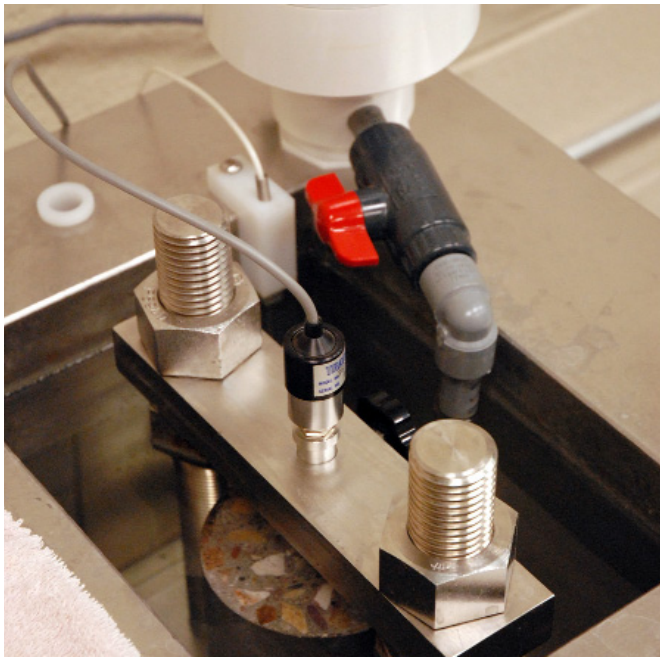
- Pavement designers (Central and Regional): ongoing training in new design technology; and input collection.
- Materials testing labs (Central and Regional): acquire new equipment (see photos at right); establish testing protocols; and establish defaults for materials and soils.
- Planning: traffic data collection; establish an effective database of inputs; and conduct falling weight deflectometer (FWD) testing.
- Pavement management: establish trigger values; monitor projects designed with the MEPDG; determine compatible definitions; and database maintenance.

Asphalt Pavement Case Study

The following example shows the potential benefits of the MEPDG in the design of asphalt pavements in Utah. The hot-mixed asphalt (HMA) section selected

for a theoretical case study is located on US-89 just north of I-70 in Utah. This section has substantial numbers of Class 13 heavy coal hauling trucks but is still in service after 24 years. The MEPDG was run over the 24-year service life with the actual traffic loadings from a nearby weigh-in-motion (WIM) station to predict longitudinal fatigue top-down cracking, alligator bottom-up fatigue cracking, mean rutting, and International Roughness Index (IRI). A comparison was then made between the predicted and measured distress and smoothness values over 24 years. Distress prediction was reasonable with the following results:

SPT apparatus for HMA

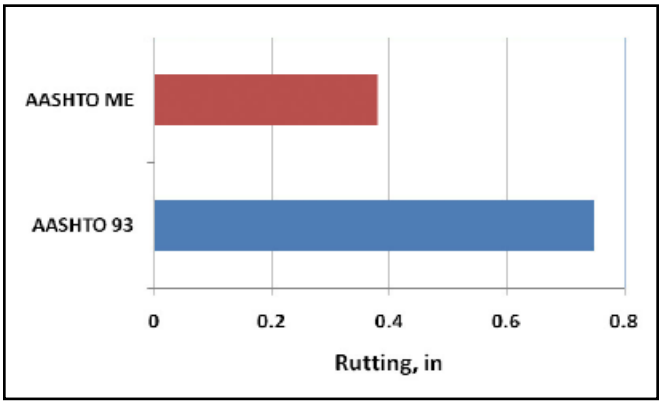


CTE apparatus for PCC

- Rutting was over 0.7-in, with most of it in the HMA layer. The mixture was an old Marshall conventional mix with a viscosity graded AC-10 binder.
- Longitudinal top-down fatigue cracking in the wheel paths was over 1,000 ft/mile, which is a moderate amount of cracking.
- Alligator bottom-up fatigue cracking was 3.6 percent lane area, which is fairly low over 24 years of service.

The following modifications allowed by the MEPDG were made in the case study design to improve performance and capacity for carrying expected traffic levels:

- The asphalt binder was changed from an AC-10 to a PG 64-34 (a polymer modified HMA mixture).
- The aggregate gradation was modified to that of the "Staker" mixture (a Utah Superpave mixture).
- Simple Performance Test (SPT) lab testing to determine the dynamic modulus, E*, of the modified HMA directly was performed in the UDOT Region Two laboratory for a range of load rates and temperatures.



The MEPDG was run with the modifications, and the predicted distresses were compared to the original pavement design as follows:

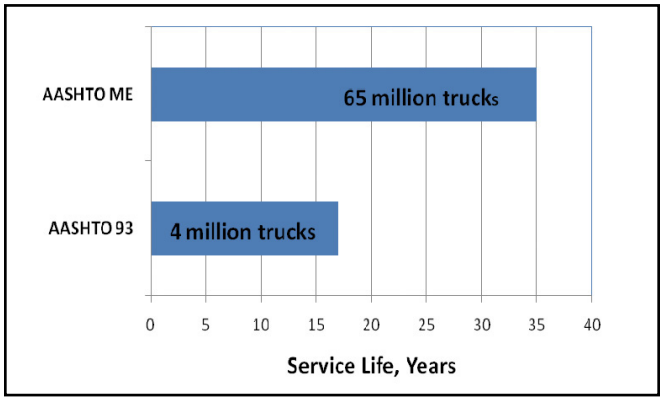
- Rutting: The modified HMA shows 50 percent less, as shown in the above bar chart.
- Longitudinal cracking: The modified HMA shows 93 percent less.
- Alligator cracking: The modified HMA shows 60 percent less.

Rigid Pavement Demonstration

The following example shows the potential benefits of the MEPDG in the design of jointed plain concrete pavement (JPCP) in Utah. The project selected for a theoretical case study was constructed in 1986 and is a 4-lane divided segment of I-15 near Nephi, Utah. The pavement is a 10-in JPCP over a lean concrete base with tied Portland cement concrete (PCC) shoulders. The joints do not include dowel bars and have a random joint spacing of 12 to 18-ft.

The MEPDG was run over the 17-year service life with the actual traffic loadings from a nearby WIM station, and the following key performance indicators were predicted: joint faulting, slab cracking, and IRI. A comparison was then made between the predicted and measured distress and smoothness values. Analysis showed the following:

- The 17 and 18-ft slabs were too long and were responsible for nearly all of the slab cracking. A contributing factor to this cracking was discovered when the coefficient of thermal expansion (CTE) of the PCC was measured as extremely high.



- The non-doweled joints faulted badly (0.18-in) resulting in a large increase in IRI (170-in/mile). The high CTE contributed to increased joint openings and loss of load transfer.

Modifications allowed by the MEPDG were made in the case study design to improve performance and capacity for carrying expected traffic levels. For this design the following changes were analyzed:

- Add 1.25-in diameter dowel bars across the transverse joint.
- Use of an aggregate in the PCC with a lower CTE.
- Use of 15-ft uniform joint spacing.

The MEPDG results with the modifications show a very significant improvement in performance manifested by a significant reduction in predicted distress and IRI after 35 years, as shown in the above bar chart and spelled out as follows:

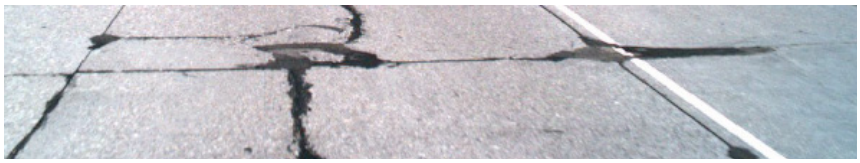
- Original design: needs rehabilitation after 4.2 million trucks in 17 years.
- Modified design: needs rehabilitation after 65 million trucks and 35 years.

The foregoing examples show the tremendous added capabilities of the MEPDG as compared to other empirical-based design procedures. This procedure would have alerted the designer to the potential problems with the original designs and could have cost effectively corrected the deficiencies prior to construction.

MEPDG Research Team

The research team that led the development of the MEPDG was Applied Research Associates and has also been assisting UDOT with implementation, with Dr. Michael Darter (mdarter@ara.com) and Mr. Harold Von Quintus leading the effort. Dr. Darter began his career with UDOT in the mid-1960's when the first AASHTO Design Guide was being implemented. Current UDOT champions on the implementation TAC include George Lukes (glukes@utah.gov) and Steven Anderson (stevenanderson@utah.gov) of Central Materials. David Stevens (davidstevens@utah.gov) of the Research Division is managing the current phase of the implementation research effort. For more information please contact the above individuals.....❑

By: Ken Berg
UDOT Engineering Services



Microsurfacing Proves Successful in Extending Life of Deteriorating Concrete Pavement

The section of concrete pavement on I-70 in Clear Creek Canyon in the Richfield District of Region Four is approximately 25 years old and is at an elevation of over 7,000 feet (Figure 1).

The pavement was placed between July 25 and September 10, 1984. Cracking of the pavement was observed 8 to 10 days after placement. The primary causes of the cracking were determined to be the bonding of the pavement to the underlying lean base course and the concrete being subjected to temperature differentials of 36° F.

Over the years, in spite of regular crack sealing efforts, the stressed concrete within the cracks gradually sloughed off, creating small to medium-sized potholes (Figure 2).

A few years ago, Scott Goodwin, Region Pavement Engineer, Larry Gay, Region Materials Associate Engineer and Les Henrie, Region Area Supervisor, visited the site and determined that a microsurface over the entire surface would seal the cracks, fill the potholes, improve the ride and, in general, extend the pavement life for a few more years.

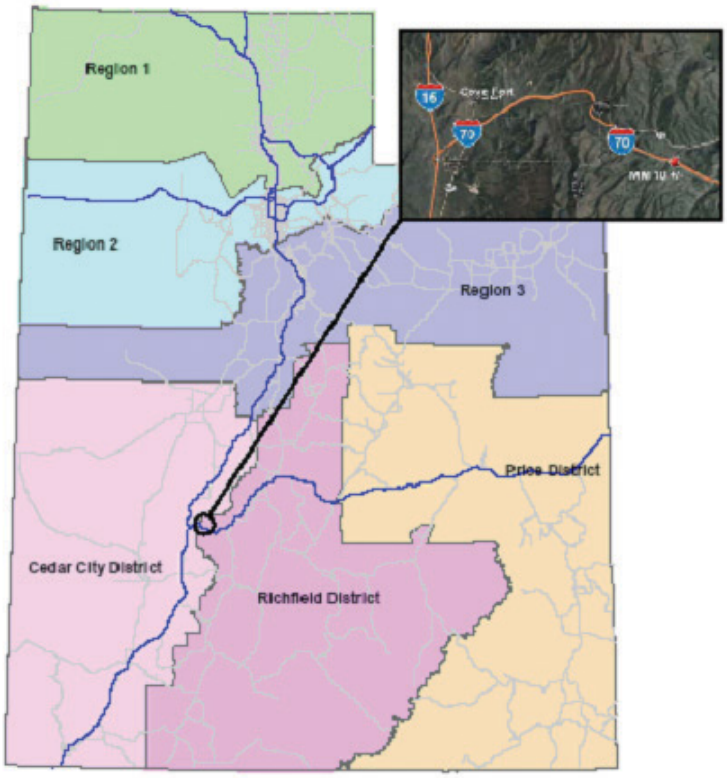


Figure 1 - Location map, I-70 in Clear Creek Canyon

Figure 2 - Twenty-one year old cracked and potholed pavement.

Figure 3 - Type III Microsurface applied on eastbound outside lane shown immediately after compaction.

In October of 2005, Intermountain Slurry Seal, Inc. of Utah applied a Type III Microsurface to the eastbound outside lane between mileposts 9.8 and 10.2 at an average thickness of approximately 1 inch. (Figure 3).

In December 2008, the site was visited by Bret Sorenson, District Maintenance Engineer, Les Henrie, Region Area Supervisor and Ken Berg, Development Engineer (Figure 4).

The treatment is considered to be successful and will be applied in other areas of the same section of I-70 in the near future.

In the words of Scott Goodwin, Region Pavement Engineer, "Richfield District feels that the cracks on this test strip are manageable now, whereas before they were becoming what seemed to them unmanageable. Also, the pop outs have been contained. Eventually, the broken pieces of concrete will be worked out by the traffic, but for the last few years they've been kept in place."

For more information contact Ken Berg, kenberg@utah.gov, (801) 965-4321.....❑

Figure 4 - December 2008 site visit. Consensus of Region Four personnel is that the pavement is in better condition than before the microsurfacing treatment.

By: Dallas Hanks and Abdul Wakil
Utah State University and UDOT Research Division

Roadside Simulation Laboratory (RSL)

The Utah Department of Transportation (UDOT) and the Utah State University (USU), Freeways to Fuel project continues to provide national leadership regarding research of roadsides for biofuel

USU researchers are exploring various methods in order to determine the possibility of growing oil-producing seed crops in nontraditional agronomic areas alongside roadways.

The latest development is the construction of a roadside simulation laboratory (RSL) at the Utah Botanical Center located in Kaysville, Utah. To more closely control experiments and gain valuable data, USU researchers have constructed a controlled environment to explore plant establishment methods in simulated roadside conditions. The simulated roadside will essentially be the "laboratory" portion of this experiment where they can more closely control conditions that will parallel observed values.

As illustrated in Figure 1, the laboratory was constructed using 6 inches of road base compacted by a 100 ton machine to a bulk density of 2 g/cm3. This action was followed by a 6 inch layer of topsoil compacted to bulk densities of approximately 1.9 g/cm3. These conditions represent the types of material and construction found along the roadsides of Interstate 15 in Utah.

With the in vivo work completed in 2007/2008 along Utah's roadsides, it is apparent that traditional methods of planting oilseed crops along Utah's roadsides will not provide the yield required to make Freeways to Fuel a viable program. The primary objectives of this research project are to determine the following:

Figure 1: Construction of Roadside Simulation Laboratory

Figure 2: Culti-planting and culti-banding

1. Will different planting techniques increase plant establishment and yields of oilseed crops under conditions of Utah roadsides?
2. Will 2008 Fall Safflower planted in roadside plots survive?

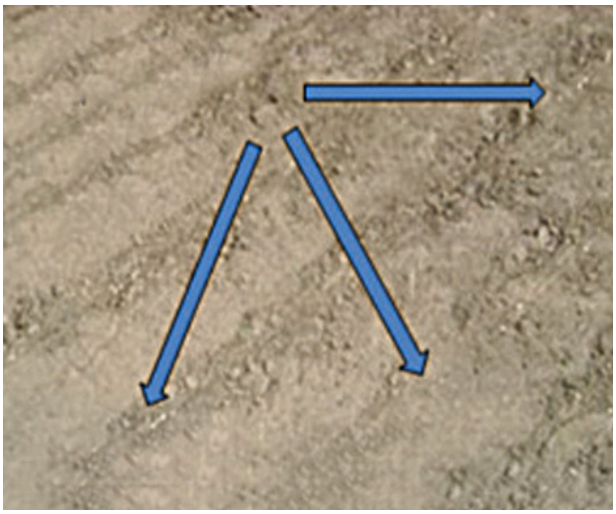
To investigate these questions, planting techniques termed culti-planting and culti-banding (Figure 2) will be tested. This research will provide data relative to the effects of minimal aeration and compost banding on planted crop yields. RSL research will explore alternative planting methods to relieve compaction without disrupting roadside function, decrease fertilizer requirements and increase water/growth conditions.

Crops to be tested will include winter safflower, spring safflower and yellow mustard. Each crop will be compared to standard no till planting, aeration + planting (culti-planting) and aeration + planting + banding of compost (culti-banding) and replicated 3 times.

Figure 3 illustrates a culti-band plot established in the concept. (pictured above) is to aerate the soil prior to planting and then band composted material over seedbeds during planting to improve soil quality, nutrient content, water retention, germination and decrease crusting and erosion - all in one pass. Plots were initiated in the fall of 2008 and will be completed in 2009.

For more information regarding this project, please contact Dallas Hanks at dallas.hanks@aggiemail.usu.edu or Abdul Wakil at awakil@utah.gov.....❑

Conventional No Till Drill



Safflower seeds on top of the ground as indicated with blue arrows

Cult-Banding Technique

Compaction relief with minimal disturbance to soil

Figure 3: Comparison of conventional no till drill to Cult-Banding technique

By: Tim Bevan
CH2MHILL

Greenroads rating system

Greenroads is a rating system to distinguish more sustainable new, reconstructed and rehabilitated roads.

Greenroads awards credits for approved sustainable choices/practices and can be used to certify projects based on total point value. Projects can be certified at four different levels depending upon total points earned.

Greenroads provides (1) a holistic way of considering roadway sustainability, (2) a defined and quantitative means to assess roadway sustainability, and (3) a tool for decision-makers, agencies, consultants and contractors that enables informed design and construction decisions regarding sustainability.

Expected Benefits

The ultimate benefit of the Greenroads rating system is more sustainable roadways. This means less impact on the environment, lower life cycle costs and more positive societal outcomes. Greenroads helps attain these goals because it can:

- Provide a system to define basic roadway sustainability attributes.
- Allow a greater audience to meaningfully participate in roadway sustainability.
- Allow sustainability tradeoffs and decisions to be made in a systematic manner.
- Provide means for sustainability assessment.
- Confer marketable recognition on sustainable roadway projects.
- Allow for sustainability innovation because it is end-result oriented.

How to Use Greenroads

The University of Washington and CH2M HILL have jointly developed the Greenroads rating system over the past two years. Greenroads has been developed to mirror the U.S. Green Build Council LEED Rating Systems that are used for certification of building projects.

Version 0.96 of Greenroads consists of seven credit categories and 57 credit subjects within categories, for a total of 76 potential points for sustainable solutions on road projects. The Greenroads credit categories and total points are listed below:

1) Project Requirements	Required/11 points
2) Environmental & Water	14 points
3) Access & Equity	14 points
4) Construction Activities	15 points
5) Materials & Resources	12 points
6) Pavement Technologies	11 points
7) Custom Credits	10 points

Documentation is available on the Greenroads website listed below along with contacts. The website provides background, technical information and research on sustainable solutions, answers to frequently asked questions, comment and suggestion forms, and reports and manuals that can be downloaded for free.

Greenroads can be implemented in a number of ways ranging from voluntary use by agencies and private enterprise to mandated goals and specifications. The Greenroads team is seeking input from practitioners regarding credits and application to highway programs; test reviews of existing projects; and test applications to Pilot Projects. Input received will be incorporated into future versions of the Greenroads rating system.

For questions, please contact Tim Bevan at tbevan@CH2M.com and Steve Muench at stmuench@u.washington.edu. The Greenroads website is located at www.greenroads.us.....❑

A Look At Who We Are

Blaine Leonard, the Research Program Manager at UDOT, was recently named the 2009 Utah Engineer of the Year by the Utah Engineers Council (UEC).

Blaine Leonard, the Research Program Manager at UDOT, was recently named the 2009 Utah Engineer of the Year by the Utah Engineers Council (UEC). Blaine was nominated for this honor by the Utah Section of ASCE. The Utah Engineers Council is a consortium of 14 engineering societies in Utah. They sponsor an annual awards banquet during Engineers Week, where they name an Engineer of the Year, Engineering Educator of the Year, and recognize engineering students with scholarships. Blaine has been with UDOT since 2001, where he has been involved with a broad variety of research efforts, including the annual UTRAC Workshop. Prior to joining UDOT, he was a consulting civil and geotechnical engineer for about 20 years in the Salt Lake area. He is currently serving as the national President-elect for ASCE.

Blaine Leonard (L) receives his award

New Research Team Member

An ongoing feature of our quarterly newsletter is an introduction to one of our Research Division staff members. In this edition, we will introduce you to Ms. Kelly Burns.

Kelly is a Rotational Engineer currently serving in the Research Division. Prior to her time with Research, Kelly completed rotations in Region Two Design, Region Two Environmental, Region Two Survey, Region Two Hydraulics, Legacy Segment Two Construction, Central Maintenance, and Central Hydraulics.

Ms. Burns graduated from University of Utah with a Bachelor's of Science degree in Civil Engineering in 2005. She has also completed the majority of a master's degree in transportation engineering and contract law.

Topping her list of enjoyable activities or hobbies are: swimming, horseback riding, kayaking and hiking in Moab.

Kelly and her husband, Greg, have one little girl named Lexie and a dog named Bridge.

We are very pleased to have Kelly as a member of our Research Team and wish her luck in her new rotation. You can contact Kelly at KBURNS@utah.gov

You Know You Need To Contact Research When...

- You would like to learn more about how a new product performs on the road.
- You have a brilliant idea and/or product and would like a team of brilliant dedicated people to research it.
- You are introduced to a promising technology and do not have time and funding to test it.
- You require any technology transfer information or any experimental feature tested.
- You have a problem to be researched and solved.
- You require diligent inquiry about a subject matter and an analysis of scientific data.

Editorial Staff

David Stevens	davidstevens@utah.gov
Abdul Wakil	awakil@utah.gov
Brook Bowen	Bowen Design Works

Completed UDOT Research

Research publications are valuable resources, documenting the results of important research projects. For a list of recently completed Research Projects, please visit the Research & Development website at: www2.udot.utah.gov/index.php?m=c&tid=235. If you would like to obtain an electronic copy or a printed copy of our completed research, please contact awakil@utah.gov.

Need a Literature Search?

The UDOT Research Division and Lester Wire Library provide an important service through literature searches. These searches help identify published information about a topic of interest. To request a search, provide a brief description and some key words and submit it to awakil@utah.gov. Or you can submit your request online at http://www.udot.utah.gov/index.php/m=c/tid=895/

Please send your comments and questions about this Newsletter to Abdul Wakil awakil@utah.gov or (801) 964-4455